HEATHKIT® MANUAL

HEATH COMPANY • BENTON HARBOR, MICHIGAN

YOUR HEATHKIT 90 DAY LIMITED WARRANTY

If you are not satisfied with our service - warranty or otherwise - or with our products, write directly to our Director of Customer Services, Heath Company, Benton Harbor, Michigan 49022. He will make certain your problems receive immediate, personal attention.

Our attorney, who happens to be quite a kitbuilder himself, insists that we describe our warranty using all the necessary legal phrases in order to comply with the new warranty regulations. Fine. Here they are:

For a period of ninety (90) days after purchase, Heath Company will replace or repair free of charge any parts that are defective either in materials or workmanship. You can obtain parts directly from Heath Company by writing us at the address below or by telephoning us at (616) 982-3571. And we'll pay shipping charges to get those parts to you — anywhere in the world.

We warrant that during the first ninety (90) days after purchase, our products, when correctly assembled, calibrated, adjusted and used in accordance with our printed instructions, will meet published specifications.

If a defective part or error in design has caused your Heathkit product to malfunction during the warranty period through no fault of yours, we will service it free upon proof of purchase and delivery at your expense to the Heath factory, any Heathkit Electronic Center (units of Schlumberger Products Corporation), or any of our authorized overseas distributors.

You will receive free consultation on any problem you might encounter in the assembly or use of your Heathkit product. Just drop us a line or give us a call. Sorry, we cannot accept collect calls.

Our warranty does not cover and we are not responsible for damage caused by the use of corrosive solder, defective tools, incorrect assembly, misuse, fire, or by unauthorized modifications to or uses of our products for purposes other than as advertised. Our warranty does not include reimbursement for customer assembly or set-up time.

This warranty covers only Heathkit products and is not extended to allied equipment or components used in conjunction with our products. **We are not responsible for incidental or consequential damages.** Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

HEATH COMPANY
BENTON HARBOR, MI. 49022

HEATH COMPANY PHONE DIRECTORY

The following telephone numbers are direct lines to the departments listed:

Kit orders and delivery information	(616) 982-3411
Credit	(616) 982-3561
Replacement Parts	(616) 982-3571

Technical Assistance Phone Numbers
8:00 A.M. to 12 P.M. and 1:00 P.M. to 4:30 P.M., EST, Weekdays Only

R/C, Audio, and Electronic Organs	(616) 982-3310
Amateur Radio	(616) 982-3296
Test Equipment, Weather Instruments and Home Clocks	(616) 982-3315
Television	(616) 982-3307
Aircraft, Marine, Security, Scanners, Automotive, Appliances and General Products	(616) 982-3496
Computers	(616) 982-3309

Prices and specifications subject to change without notice.

Heathkit® Manual

for the

CAPACITOR SUBSTITUTION BOX

Model IN-3147

595-1968-04

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HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

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SPECIFICATIONS

Range	0.0001 μfd through .22 μfd.
Voltage Rating	0.0001 μfd through .00047 μfd: 500 volts. 0.001 μfd through .1 μfd: 600 volts. 0.15 μfd through .22 μfd: 400 volts.
Accuracy	0.0001 μfd through .00047 μfd: ±5%. 0.01 through .22 μfd: ± 10%.
Components	Silver mica and Mylar. *
Dimensions	6" long x 3" wide x 3" high.
Net Weight	1 lb.

*DuPont Registered Trademark

The Heath Company reserves the right to discontinue products and to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.

Refer to the "Kit Builders Guide" for information on parts, tools, wiring, and soldering.

DESCRIPTION

The Model IN-3147 Capacitor Substitution Box has been designed to provide a fast and convenient means of determining proper capacitance values for circuit substitution or circuit experimentation, eliminating time-consuming calculation.

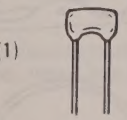
The special rotary switch incorporates make-before-break contacts that provide smooth changes in capacitance without "opening" or "shorting" the circuit under test.

PARTS LIST

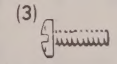
Unpack the kit carefully and check each part against the Parts List. The numbers in parentheses in the Parts List correspond to the numbers of the parts drawings to aid in quick and positive parts identification.

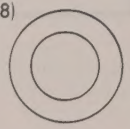
To order a replacement part, use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of the Manual. For pricing information, refer to the separate "Heath Parts Price List."

PART No.	PARTS Per Kit	DESCRIPTION
CAPACITORS		
(1) 20-102	1	.0001 μfd (100 μμf) mica
20-120	1	.00022 μfd (220 μμf) mica
20-707	1	.00047 μfd (470 μμf) mica
(2) 27-101	1	.001 μfd Mylar
27-102	1	.0015 μfd Mylar
27-103	1	.0022 μfd Mylar
27-91	1	.0033 μfd Mylar
27-104	1	.0047 μfd Mylar
27-105	1	.0068 μfd Mylar
27-106	1	.01 μfd Mylar
27-107	1	.015 μfd Mylar
27-108	1	.022 μfd Mylar
27-109	1	.033 μfd Mylar
27-110	1	.047 μfd Mylar
27-111	1	.068 μfd Mylar
27-112	1	.1 μfd Mylar
27-113	1	.15 μfd Mylar
27-114	1	.22 μfd Mylar

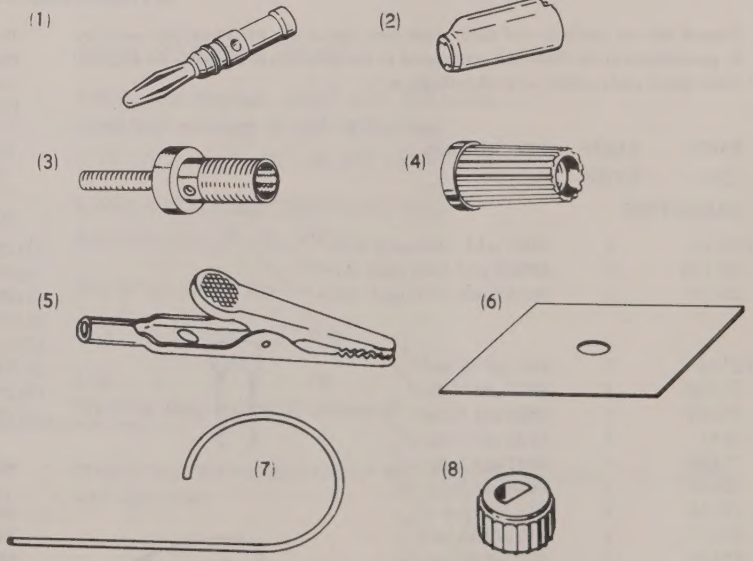


PART No.	PARTS Per Kit	DESCRIPTION
HARDWARE		
(3) 250-213	4	4-40 screw
(4) 252-3	2	6-32 nut
(5) 252-7	1	Control nut
(6) 253-1	2	Fiber flat washer
(7) 253-2	2	Fiber shoulder washer
(8) 253-10	1	Control flat washer
(9) 254-4	1	Control lockwasher
(10) 259-1	2	Solder lug
WIRE-SLEEVING		
341-1	1	Black test lead
341-2	1	Red test lead
344-59	1	Hookup wire
346-1	1	Sleeving





PART No.	PARTS Per Kit	DESCRIPTION
MISCELLANEOUS		
(1) 438-47	2	Banana plug
(2) 70-10	1	Black banana plug insulator
70-11	1	Red banana plug insulator
(3) 427-3	2	Binding post base
(4) 100-16-2	1	Black binding post cap
100-16-18	1	Red binding post cap
(5) 260-1	2	Alligator clip
(6) 75-12	1	Plastic insulator
63-451	1	18-position rotary switch
203-417-3	1	Front panel
408-11	1	Case
462-999	1	Knob
(7) 213-2	1	Capacitor connecting wire
(8) 455-619	1	Knob bushing
391-34	1	Blue and white identification label
597-260	1	Parts Order Form
597-308	1	Kit Builders Guide
	1	Manual (See front cover for part number)
		Solder



ASSEMBLY NOTES

The following instructions are presented in a logical step-by-step sequence to enable you to complete your kit with the least possible confusion. Be sure to read each step all the way through before beginning the specified operation. Also read several steps ahead of the actual step being performed. This will familiarize you with the relationship of the subsequent operations. When the step is completed, check it off in the space provided. This is particularly important, as it may prevent errors or omissions, especially if your work is interrupted.

In general, the illustrations in this manual correspond to the actual configuration of the kit; however, in some instances the illustrations may be slightly distorted to facilitate clearly showing all of the parts.

The abbreviation "NS" indicates that a connection should not be soldered yet as other wires will be added. When the last wire is installed, the terminal should be soldered and the abbreviation "S" is used to indicate this. Note that a number will appear after each solder instruction. This number indicates the number of leads that are supposed to be connected to the terminal in point before it is soldered. For example, if the instruction reads, "Connect a lead to lug 1 (S-2)," it will be understood that there will be two leads connected to the terminal at the time it is soldered.

Position the work, if possible, so that gravity will help to keep the solder where you want it. The joint to be soldered should be heated with the flat side of the soldering iron tip sufficiently to melt the solder. Apply only enough solder to the heated terminal to thoroughly wet the junction. Remove the solder and then the iron when a smooth soldered junction appears. Do not move the leads until the solder is solidified.

ROSIN CORE SOLDER HAS BEEN SUPPLIED WITH THIS KIT. THIS TYPE OF SOLDER MUST BE USED FOR ALL SOLDERING IN THIS KIT. ALL GUARANTEES ARE VOIDED AND WE WILL NOT REPAIR OR SERVICE EQUIPMENT IN WHICH ACID CORE SOLDER OR PASTE FLUXES HAVE BEEN USED. IF ADDITIONAL SOLDER IS NEEDED, BE SURE TO PURCHASE ROSIN CORE (60:40 or 50:50 TIN-LEAD CONTENT) RADIO TYPE SOLDER.

STEP-BY-STEP ASSEMBLY

MECHANICAL ASSEMBLY

Before starting to assemble this kit, read the Kit Builders Guide for information on wiring and soldering.

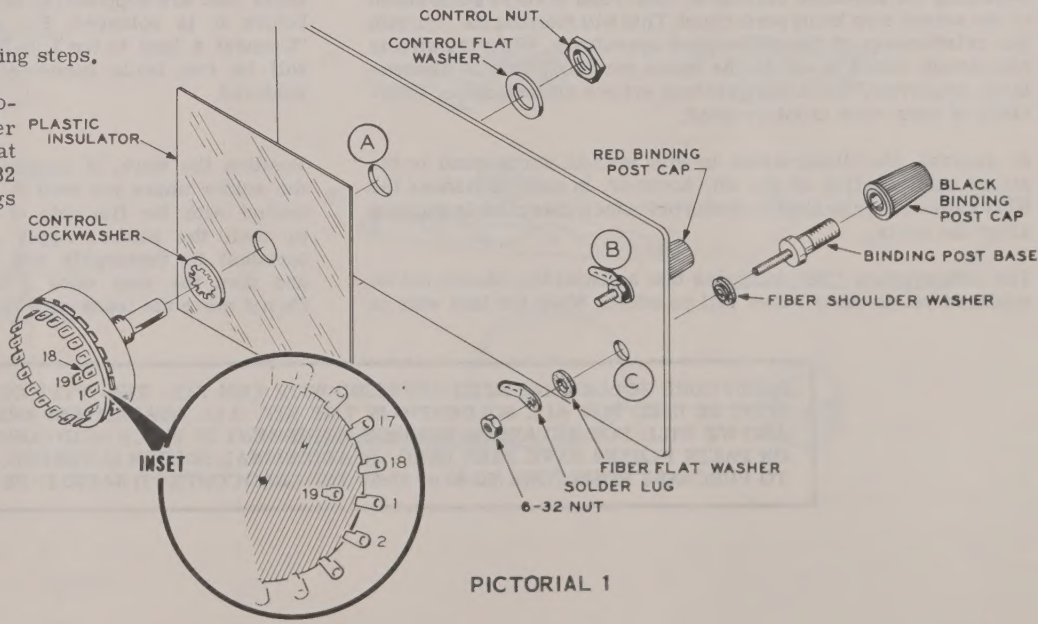
Refer to Pictorial 1 for the following steps.

(✓) Install binding post bases at locations B and C. Use fiber shoulder washers, fiber flat washers, solder lugs, and 6-32 nuts. Position the solder lugs as shown.

(✓) Install a red binding post cap on B and a black binding post cap on C.

(✓) With a pair of pliers, rotate the shaft until the wiper lines up with lug 18, indicated by the arrow. The wiper can be seen through the openings in the edge of the switch.

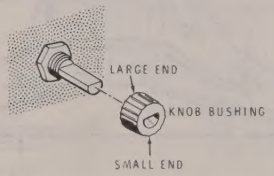
(✓) Install the plastic insulator and rotary switch at location A. Use a control lockwasher, control flat washer, and a control nut. Position lug 19 (see the inset drawing) toward the binding post bases as shown.



PICTORIAL 1

KNOB INSTALLATION

The knob supplied with this kit uses a knob bushing that provides permanent positive action without the use of setscrews.

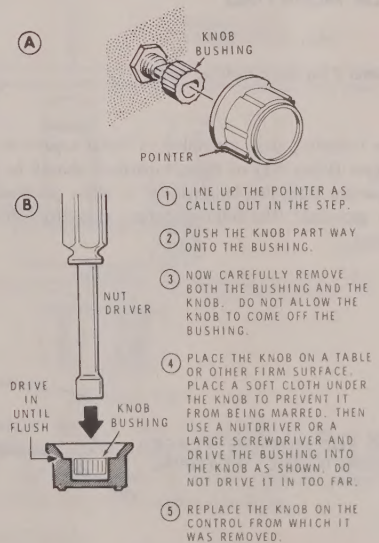


Detail 1A

Refer to Detail 1A and notice that the knob bushing is tapered. Be sure, in the next step, to place this bushing on the shaft with the small end facing out, or the knob will not slide onto it. (Roll the bushing on a flat surface if you are unsure about it; the bushing will gradually turn toward the small end.)

(✓) Place a knob bushing on the switch shaft.

NOTE: Perform the next step carefully, since it is difficult to remove a bushing from a knob once it is fully inserted.


A
KNOB BUSHING
POINTER
B
NUT DRIVER
DRIVE IN UNTIL FLUSH
KNOB BUSHING
1 LINE UP THE POINTER AS CALLED OUT IN THE STEP.
2 PUSH THE KNOB PART WAY ONTO THE BUSHING.
3 NOW CAREFULLY REMOVE BOTH THE BUSHING AND THE KNOB. DO NOT ALLOW THE KNOB TO COME OFF THE BUSHING.
4 PLACE THE KNOB ON A TABLE OR OTHER FIRM SURFACE. PLACE A SOFT CLOTH UNDER THE KNOB TO PREVENT IT FROM BEING MARRED. THEN USE A NUTDRIVER OR A LARGE SCREWDRIVER AND DRIVE THE BUSHING INTO THE KNOB AS SHOWN. DO NOT DRIVE IT IN TOO FAR.
5 REPLACE THE KNOB ON THE CONTROL FROM WHICH IT WAS REMOVED.

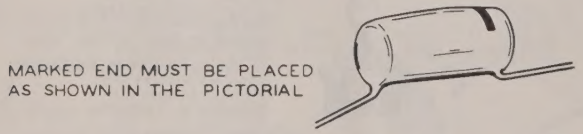
Detail 1B

(✓) Refer to Detail 1B and install the knob on the switch shaft. Line up the pointer with the .0001 position on the panel.

CAPACITOR MOUNTING

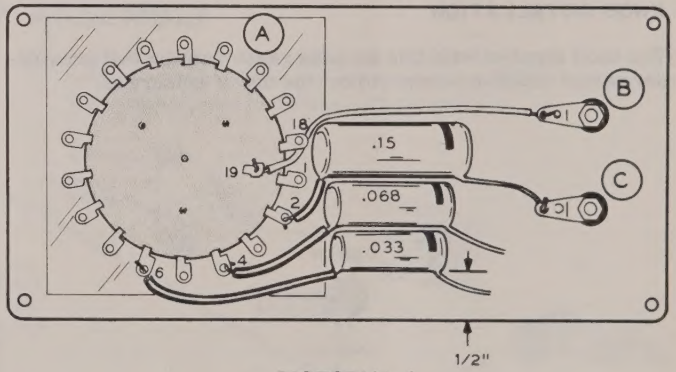
Refer to Pictorial 2 for the following steps.

NOTE: In the following steps a number of Mylar capacitors will be installed. The marked end (see Detail 2A) of these capacitors should be positioned as shown. Leave the capacitor leads just long enough to allow positioning each capacitor as shown in the pictorials. The following three capacitors should be pressed down against the panel.



Detail 2A

(✓) Connect one lead of a .033 µfd Mylar capacitor to lug 6 of switch A (S-1). Use sleeving. Position the capacitor about 1/2" from the edge of the panel, so the case will fit properly. The other lead will be connected later.

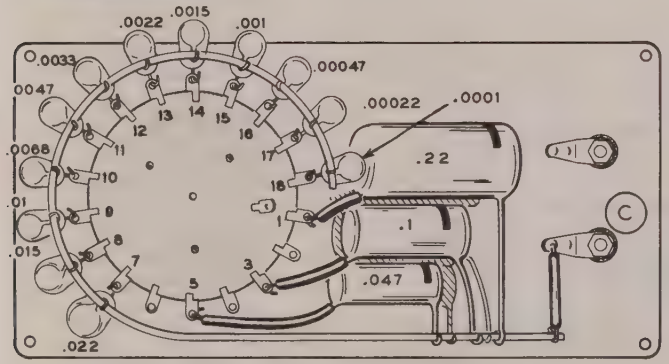


PICTORIAL 2

(✓) Connect a .068 µfd Mylar capacitor from lug 4 of switch A (S-1). Use sleeving. The other lead will be connected later.

(✓) Connect a .15 µfd Mylar capacitor from lug 2 of switch A (S-1) to solder lug C (NS). Use sleeving on the lead to the switch.

(✓) Strip 1/4" of insulation from the ends of a 3-1/2" hookup wire. Connect this wire from lug 19 of switch A (S-1) to solder lug B (S-1). Position the wire between lugs 1 and 18 of the switch.



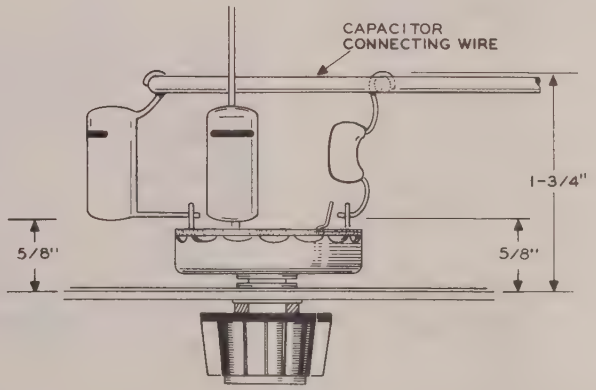
PICTORIAL 3

Refer to Pictorial 3 for the following steps.

(✓) Connect one lead of a .22 μfd Mylar capacitor to lug 1 of switch A (S-1). Use sleeving. Position the capacitor directly on top of the .15 μfd capacitor. The other lead will be connected later.

(✓) Connect one lead of a .1 μfd Mylar capacitor to lug 3 of switch A (S-1). Use sleeving. Position this capacitor directly on top of the .068 μfd capacitor. The other lead will be connected later.

(✓) Connect one lead of a .047 μfd Mylar capacitor to lug 5 of switch A (S-1). Use sleeving. Position this capacitor directly on top of the .033 μfd capacitor. The other lead will be connected later.



Detail 3A

Refer to Detail 3A, connect the lead from the unmarked end of each of the following capacitors to switch A. Position the capacitors as shown, and keep them at least 1/2" from the edge of the panel, so the case will fit properly. Do not install the capacitor connecting wire until instructed to do so.

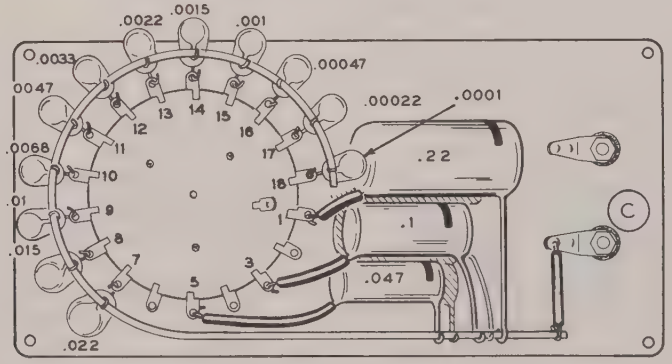
(✓) .022 μfd Mylar to lug 7 (S-1).

(✓) .015 μfd Mylar to lug 8 (S-1).

(✓) .01 μfd Mylar to lug 9 (S-1).

(✓) .0068 μfd Mylar to lug 10 (S-1).

(✓) .0047 μfd Mylar to lug 11 (S-1).



PICTORIAL 3
(Repeat)

( ) .0033 μfd Mylar to lug 12 (S-1).

( ) .0022 μfd Mylar to lug 13 (S-1).

( ) .0015 μfd Mylar to lug 14 (S-1).

( ) .001 μfd Mylar to lug 15 (S-1).

( ) .00047 μfd (470 μμf) mica to lug 16 (S-1).

( ) .00022 μfd (220 μμf) mica to lug 17 (S-1).

( ) .0001 μfd (100 μμf) mica to lug 18 (S-1).

( ) Locate the capacitor connecting wire; position it as shown in Pictorial 3 and Detail 3A.

( ) Bend the free leads of the capacitors connected to switch lugs 7, 12, and 18 around the capacitor connecting wire, to hold the connecting wire 1-3/4" above the panel, and in the position shown. Carefully position the wire and then solder the three connections.

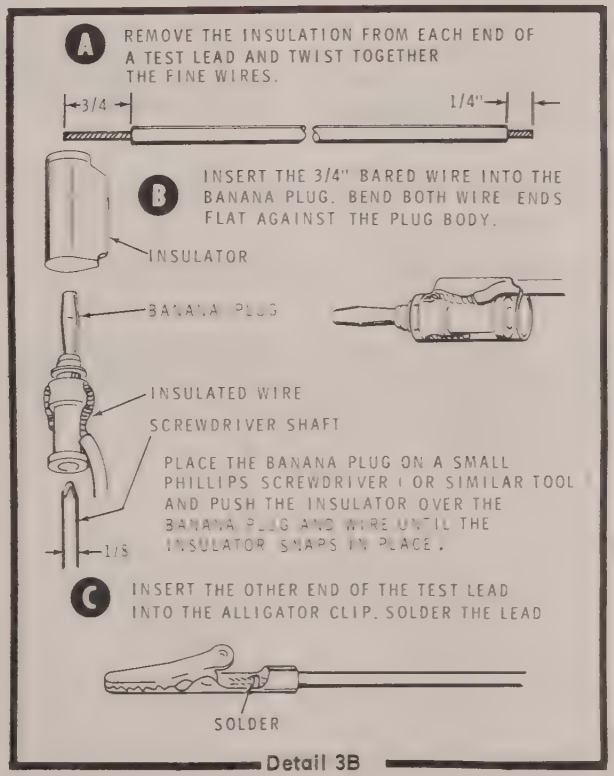
( ) Strip 1/4" of insulation from the ends of a 1-3/4" hookup wire. Connect this wire from solder lug C (S-3) to the end of the capacitor connecting wire (S-1).

( ) Connect the free wires of the .22 μfd. .1 μfd. .068 μfd. .033 μfd. and .047 μfd capacitors to the capacitor connecting wire and solder each connection.

( ) Now connect the free lead of each remaining capacitor to the capacitor connecting wire. Solder each connection.

( ) Referring to Detail 3B, prepare a black and a red test lead as shown. Use the black banana plug insulator on the black lead, and the red banana plug insulator on the red lead.

This completes the wiring. Check to see that all connections are soldered, and shake out any wire clippings or solder splashes.

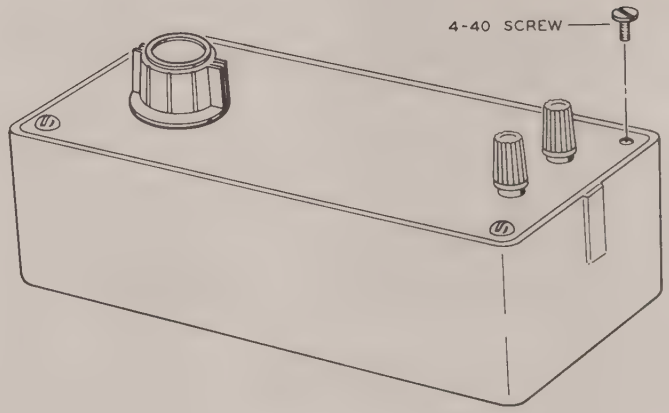

A
REMOVE THE INSULATION FROM EACH END OF A TEST LEAD AND TWIST TOGETHER THE FINE WIRES.
3/4
1/4"
B
INSERT THE 3/4" BARED WIRE INTO THE BANANA PLUG. BEND BOTH WIRE ENDS FLAT AGAINST THE PLUG BODY.
INSULATOR
BANANA PLUG
INSULATED WIRE
SCREWDRIVER SHAFT
PLACE THE BANANA PLUG ON A SMALL PHILLIPS SCREWDRIVER (OR SIMILAR TOOL) AND PUSH THE INSULATOR OVER THE BANANA PLUG AND WIRE UNTIL THE INSULATOR SNAPS IN PLACE.
1/8
C
INSERT THE OTHER END OF THE TEST LEAD INTO THE ALLIGATOR CLIP. SOLDER THE LEAD
SOLDER
Detail 3B

NOTE: The blue and white identification label shows the Model Number and Production Series Number of your kit. Refer to these numbers in any communications with the Heath Company; this assures you that you will receive the most complete and up-to-date information in return.

(✓) Carefully peel away the backing paper from the identification label. Then press the label into position on the inside of the case.

( ) Referring to Pictorial 4, install the case, using the 4-40 screws.

NOTE: The mica capacitors have a working voltage rating of 500 volts. The .0033 μfd capacitor is rated at 1000 volts. All other capacitors have a rating of 600 volts. These ratings are all conservative; the capacitors can withstand intermittent overloads of as much as 200%.



PICTORIAL 4

IN CASE OF DIFFICULTY

1. Recheck the wiring. Trace each lead in colored pencil on the Pictorial as it is checked. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something consistently overlooked by the constructor.

2. It is interesting to note that about 90% of the kits that are returned for repair do not function properly due to poor connections and soldering. Therefore, many troubles can be eliminated by reheating all connections to make sure that they are soldered properly.

3. Check the values of the component parts. Be sure that the proper part has been wired into the circuit, as shown in the pictorial diagrams and as called out in the wiring instructions.

4. Check for bits of solder, wire ends or other foreign matter which may be lodged in the wiring.

5. Make sure the knob is properly installed. The value indicated by the knob pointer should correspond to the capacitor selected by the switch.

NOTE: In an extreme case where you are unable to resolve a difficulty, refer to the "Customer Service" information on the inside rear cover of this manual. Your warranty is located inside the front cover.

CUSTOMER SERVICE

REPLACEMENT PARTS

Please provide complete information when you request replacements from either the factory or Heath Electronic Centers. Be certain to include the **HEATH** part number exactly as it appears in the parts list.

Replacement parts are maintained specifically to repair Heath products. Parts sales for other reasons will be declined.

ORDERING FROM THE FACTORY

Print all of the information requested on the parts order form furnished with this product and mail it to Heath. For telephone orders (parts only) dial 616 982-3571. If you are unable to locate an order form, write us a letter or card including:

- Heath part number.
- Model number.
- Date of purchase.
- Location purchased or invoice number.
- Nature of the defect.
- Your payment or authorization for COD shipment of parts not covered by warranty.

Mail letters to: Heath Company
Benton Harbor
MI 49022
Attn: Parts Replacement

Retain original parts until you receive replacements. Parts that should be returned to the factory will be listed on your packing slip.

OBTAINING REPLACEMENTS FROM HEATH ELECTRONIC CENTERS

For your convenience, "over the counter" replacement parts are available from the Heath Electronic Centers listed in your catalog. Be sure to bring in the original part and purchase invoice when you request a warranty replacement from a Heath Electronic Center.

TECHNICAL CONSULTATION

Need help with your kit? — Self-Service? — Construction? — Operation? — Call or write for assistance. you'll find our Technical Consultants eager to help with just about any technical problem except "customizing" for unique applications.

The effectiveness of our consultation service depends on the information you furnish. Be sure to tell us:

- The Model number and Series number from the blue and white label.
- The date of purchase.
- An exact description of the difficulty.
- Everything you have done in attempting to correct the problem.

Also include switch positions, connections to other units, operating procedures, voltage readings, and any other information you think might be helpful.

Please do not send parts for testing, unless this is specifically requested by our Consultants.

Hints: Telephone traffic is lightest at midweek — please be sure your Manual and notes are on hand when you call.

Heathkit Electronic Center facilities are also available for telephone or "walk-in" personal assistance.

REPAIR SERVICE

Service facilities are available, if they are needed, to repair your completed kit. (Kits that have been modified, soldered with paste flux or acid core solder, cannot be accepted for repair.)

If it is convenient, personally deliver your kit to a Heathkit Electronic Center. For warranty parts replacement, supply a copy of the invoice or sales slip.

If you prefer to ship your kit to the factory, attach a letter containing the following information directly to the unit:

- Your name and address.
- Date of purchase and invoice number.
- Copies of all correspondence relevant to the service of the kit.
- A brief description of the difficulty.
- Authorization to return your kit COD for the service and shipping charges. (This will reduce the possibility of delay.)

Check the equipment to see that all screws and parts are secured. (Do not include any wooden cabinets or color television picture tubes, as these are easily damaged in shipment. Do not include the kit Manual.) Place the equipment in a strong carton with at least THREE INCHES of *resilient* packing material (shredded paper, excelsior, etc.) on all sides. Use additional packing material where there are protrusions (control sticks, large knobs, etc.). If the unit weighs over 15 lbs., place this carton in another one with 3/4" of packing material between the two.

Seal the carton with reinforced gummed tape, tie it with a strong cord, and mark it "Fragile" on at least two sides. Remember, the carrier will not accept liability for shipping damage if the unit is insufficiently packed. Ship by prepaid express, United Parcel Service, or insured Parcel Post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022

www.manualsplus.com
1001992

HEATH
Schlumberger

HEATH COMPANY • BENTON HARBOR, MICHIGAN

THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM

LITHO IN U.S.A.